NEUROIMAGING IN MENTAL RETARDATION

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CERTIFICATE

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I declare that this dissertation entitled **"NEUROIMAGING IN MENTAL RETARDATION"** has been conducted by me at the Institute of Child Health and Hospital for Children, Egmore, Chennai – 600 008, under the guidance and supervision of my unit Chief **Prof.Dr.R.Kandasamy, M.D., D.C.H., Prof.Dr.N.Thilothammal, M.D., DM (Neurology)** and **Prof.Dr.Saradha Suresh, M.D., Ph.D. F.R.C.P. (Glas.).** It is submitted in part fulfillment of the award of the degree of **M.D. (Paediatrics)** for the March-2009 examination to be held under **The Tamilnadu Dr.M.G.R.Medical University, Chennai**. This has not been submitted previously by me for the award of any degree or diploma from any other University.

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CONTENTS

Serial No.	Title	Page No.
1.	INTRODUCTION	1
2.	AIM	23
3.	MATERIALS AND METHODS	23
4.	REVIEW OF LITERATURE	34
5.	ANALYSIS AND DISCUSSION	49
7.	CONCLUSION	52
8.	REFERENCES	

INTRODUCTION

DEFINITION

Mental retardation is defined as " significantly sub-average intellectual functioning, existing concurrently with deficits in adaptive behavior and manifested during the developmental period that adversely affects child's educational performance ". The most commonly used medical diagnostic criteria for mental retardation are those contained in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV -TR) The DSM-IV classifies four different degrees of mental retardation: mild, moderate, severe, and profound. These categories are based on the functioning level of the individual. The classification of mental retardation that results from these definitions has been criticized for depending on IQ test performance rather than adaptive behavior, not taking the standard error of measurement into account, and not being predictive of outcomes for individuals.

AAMR classifications

The American Association on Mental Retardation (AAMR) has developed another widely accepted diagnostic classification system for mental retardation. The AAMR classification system focuses on the capabilities of retarded individuals rather than on their limitations. The categories describe the level of support required, including

intermittent support, limited support, extensive support. To some extent, the AAMR classification mirrors the DSM-IV-TR classification. Intermittent support, for example, is support that is needed only occasionally, perhaps during times of stress or crisis for the retarded person. It is the type of support typically required for most mildly retarded people. At the other end of the spectrum, pervasive support, which is life-long, daily support for most adaptive areas, would be required for profoundly retarded persons. The AAMR classification system refers to the "below-average intellectual function" as an IQ of 70–75 or below.

DIAGNOSTIC CRITERIA FOR MENTAL RETARDATION

There are three diagnostic criteria before a person is considered to have a mental retardation:

1. Significantly sub-average intellectual functioning: an IQ score of ~ 70 or below on an individually administered IQ test

2. Concurrent deficits or impairments in present adaptive functioning in at least two of the following areas, communication, self-help skills, home living, social/interpersonal skills, use of community resources, self direction, functional academic skills, work, leisure, health and safety.

3. Onset before the age of 18 years.

Mild mental retardation	:	IQ level 50-55 to ~70
Moderate mental retardation	:	IQ level 35-40 to 50 - 55
Severe mental retardation	:	IQ level 20-25 to 35 - 40
Profound mental retardation	:	IQ level below 20 – 25
Mental retardation, severity unspecified	:	When there is a strong presumption of mental retardation but the person's intelligence is untestable by standard tests.

Mental retardation begins in childhood or adolescence before the age of 18. In most cases, it persists throughout adult life. A diagnosis of mental retardation, intellectual functioning level is defined by standardized tests that measure the ability to reason in terms of mental age (Intelligence Quotient or IQ). Mental retardation is defined as an IQ score below 70–75; a normal score is 100. Adaptive skills refer to skills needed for daily life. Such skills include the ability to produce and understand language (communication); home-living skills; use of community resources; health, safety, leisure, self-care, and social skills; self-direction; functional academic skills (reading, writing, and arithmetic); and job-related skills.

In general, mentally retarded children reach such developmental milestones as walking and talking much later than children in the general population. Symptoms of mental retardation may appear at birth or later in childhood. The child's age at onset depends on the suspected cause of the disability. Some cases of mild mental retardation are not diagnosed before the child enters preschool or kindergarten. These children

typically have difficulties with social, communication, and functional academic skills. Children who have a neurological disorder illness such as encephalitis or meningitis may suddenly show signs of cognitive impairment and adaptive difficulties.

ETIOLOGY

Mild mental retardation (IQ >50) is more associated with environmental influences and severe mental retardation (IQ <50) is more frequently associated with biologic causes. Mild mental retardation is four times more likely to be found in the offspring of woman who have not completed high school than in woman who have been gradguated. This presumably consequences of both genetic and socioeconomic factors like undernutrition and poverty.

The specific cause of mild mental retardation are currently identifiable in less than 50% of affected individuals. The most common causes of mild mental retardation include genetic syndromes with multiple minor congenital anomalies, fetal deprivation, prematurity, perinatal insults, intrauterine exposure to drugs of abuse and sex chromosomal abnormalities.

In children with severe mental retardation biologic cause can be identified in > 75% of cases. A variety of problems can lead to mental retardation. The three most common causes of mental retardation, accounting for about 30% of cases, are Down syndrome, fragile X, and fetal alcohol syndrome. In about 40% of cases, the cause of

mental retardation cannot be found. The causes of mental retardation can be divided into broad classifications, including genetic factors, prenatal illnesses and exposures, childhood illnesses and injuries, and environmental factors.

GENETIC FACTORS:

About 30% of cases of mental retardation are caused by hereditary factors. Mental retardation may be caused by an inherited genetic abnormality such as fragile X syndrome. Fragile X, a defect in the chromosome that determines sex, is the most common inherited cause of mental retardation. Single-gene defects such as phenylketonuria (PKU) and other inborn errors of metabolism may also cause mental retardation if they are not discovered and treated early. An accident or mutation in genetic development may also cause retardation. Examples of such accidents are development of an extra chromosome 18 (trisomy 18) and Down syndrome. Down syndrome, also called mongolism or trisomy 21, is caused by an abnormality in the development of chromosome 21. It is the most common genetic cause of mental retardation.

PRENATAL ILLNESSES AND EXPOSURES

Fetal alcohol syndrome affects one in 3,000 children in Western countries. Fetal alcohol syndrome results from the mother's heavy drinking during the first 12 weeks of pregnancy. Some studies have shown that even moderate alcohol use during pregnancy

may cause learning disabilities in children. Drug abuse and tobacco smoking during pregnancy have also been linked to mental retardation. It is generally accepted that pregnant women should avoid all alcohol, tobacco, and recreational drugs.

Maternal infections and such illnesses as glandular disorders, rubella, toxoplasmosis, and cytomegalovirus infection may cause mental retardation. When the mother has high blood pressure or blood poisoning, the flow of oxygen to the fetus may be reduced, causing brain damage and mental retardation.

Birth defects that cause physical deformities of the head, brain, and central nervous system frequently cause mental retardation. Neural tube defect, for example, is a birth defect in which the neural tube that forms the spinal cord does not close completely. This defect may cause children to develop an accumulation of cerebrospinal fluid inside the skull. Hydrocephalus can cause learning impairment by putting pressure on the brain.

CHILDHOOD ILLNESSES AND INJURIES

Hyperthyroidism, whooping cough, chicken pox, measles, and Hemophilus influenza B disease may cause mental retardation if they are not treated adequately. An infection of the membrane covering the brain (meningitis) or an inflammation of the brain itself (encephalitis) can cause swelling that in turn may cause brain damage and mental retardation. Traumatic brain injury caused by a blow to the head or by violent

shaking of the upper body may also cause brain damage and mental retardation in children.

ENVIRONMENTAL FACTORS

Ignored or neglected infants who are not provided with the mental and physical stimulation required for normal development may suffer irreversible learning impairment. Children who live in poverty and suffer from malnutrition, unhealthy living conditions, abuse, and improper or inadequate medical care are at a higher risk. Exposure to lead or mercury can also cause mental retardation. Many children have developed lead poisoning from eating the flaking lead-based paint often found in older buildings.

EPIDEMIOLOGY:

The prevalence of mental retardation depends on the definition, method of ascertainment and the population. According to APA definition 2.5% of population should have mental retardation. 85% of this individual should fall into range of mild mental retardation. Prevalence of severe mental retardation has not changed appreciably since 1940 and is approximately 0.3 to 0.5% of population.

Mental retardation occurs more frequently in boys than in girls 2:1 in mild mental retardation, 1.5:1 in severe mental retardation. In part this may be a consequences of the

many X linked disorders associated with intellectual disability, most prominent being fragile X syndrome.

PATHOGENESIS

The limitation on our knowledge of the neuropathology of intellectual disability or exemplified by the fact that 10 to 20 % of brains of individual with severe mental retardation appear entirely normal by standard neuropathology study. The majority of brains of this individual show only mild nonspecific changes that correlate poorly with degree of intellectual disability. This changes include microcephaly, grey matter heterotopias in sub cortical white matter, unusually regular columnar arrangement of the cortex, and neurons that are more tightly packed than usual. Only a minority of brain shows more specific changes in dendritic and synoptic organization, with dysgenesis of dendritic spine or cortical pyramidal neuron, or impaired growth of dendritic trees.

The programming of central nervous system involves a process of induction. CNS maturation is defined in terms of genetic, molecular, autocrine, paracrine, and endocrine influences. Receptors, signaling molecules, and genes are critical to brain development. The maintanace of different neuronal phenotypes in the adult brain involves the same genetic transcription. They play a crucial role during fetal development with activation of similar intracellular transduction mechanisms. Several syndromes that were thought to involve complex chromosomal abnormalities are caused by single gene mutations involving induction. Rubinstein taybi syndrome, a disorder marked clinically by broad

thumbs and great toes, characteristic facies and severe mental retardation has been showed to result from mutation in the gene encoding for the transcriptional coactivator CREB binding proteins (CBEP), a factor important in the control of gene expression in early embryogenesis.

CLINICAL MANIFESTATION

Early diagnosis of mental retardation facilitates earlier intervention, realistic goal setting, easing of prenatal anxiety and greater acceptance of child in the community.

Most children with intellectual disability first come to the paediatrician attention in infancy because of dysmorphisms, associated dysfunctions, or failure to meet age – appropriate developmental milestone.

There are no specific characterstics of intellectual disability, but dysmorphisms are the earliest signs. They may comprise a genetic syndrome such as down syndrome or be isolated as in microcephaly. Associated dysfunction are neurological disorders like seizures, cerebral palsy, autisms, that are seen in conjunction with mental retardation than in general population. Most children with intellectual disability may not keep with their peers and failed to meet age expected norms. In early infancy failure to meet age appropriate expectation may include a lack of visual or auditory responsiveness, unusual muscle tone, or posture, and feeding difficulties. Between 6 and 8 months of age, motor delay, lack of sitting crawling, walking is the most common complaint. Language delay

and behavior problem are more concerns after 18 months. Early identification of atypical development is slightly to occur with more severe impairments. Mental retardation is usually identifiable by age 3 years.

INVESTIGATIONS

The most commonly used medical diagnostic testing for children with mental retardation include neuroimaging, metabolic, genetic, and chromosomal blood testing and electroencephalography (EEG).

These tests should not be used as screening tests for all children with an intellectual disability.

Decisions on diagnostic testing should be based on medical/family history, physical examination, testing by other disciplines and the family's wishes.

Suggested evaluation of the child with mental retardation:

1. History: Detailed history including pre, peri and postnatal events including seizures, developmental milestones and 3 generation pedigree in family history.

2. Physical examination: Particular attention to subtle abnormalities, neurological examination for focalities and skull abnormalities.

3. Vision/hearing evaluation

4. Karyotyping is indicated in children with multiple anomalies or a positive family history. Helps in 3.7%.

5. Molecular genetic studying for Fragile X syndrome for a male with moderate mental retardation, unusual physical features, and/or a family history of mental retardation. Or a female with more subtle cognitive deficits associated with severe shyness and a relevant family history. Helps in 2.6%

6. Neuroimaging in children with abnormal head growth or asymmetric and new or focal neurologic findings. Positives increased by abnormalities of skull shape and size, focal neurological findings. Helps in 40 – 55%

7. A child with progressive neurologic disorder or acute behavioral changes will need metabolic investigation which include urinary organic acids, plasma aminoacids, blood lactate, lysosomal enzymes in lymphocytes. Helps in~1%.

8. EEG in children with history of seizures. Helps in ~1%.

9. Thyroid function testing helps in ~4%

10. Serum lead if there are identifiable risk factors for excessive environmental exposure.

DIAGNOSIS

It is formally diagnosed by professional assessment of intelligence and adaptive behavior.

If mental retardation is suspected, a comprehensive physical examination and medical history should be done immediately to discover any organic cause of symptoms. Such conditions as hyperthyroidism and PKU are treatable. The progression of retardation can be stopped and, in some cases, partially reversed if these conditions are discovered early. If a neurological cause such as brain injury is suspected, the child may be referred to a neurologist or neuropsychologist for testing.

A complete medical, family, social, and educational history is compiled from existing medical and school records and from interviews with parents. Children are given intelligence tests to measure their learning abilities and intellectual functioning.

INTELLIGENT QUOTIENT: (IQ)

Expresses intelligence as a ratio of mental age to chronological age.

IQ = mental age/ chronological age x100

100 is used as a multiplier to remove the decimal point and to make IQ have a value of 100 when mental age equals chronological age.

Such tests include the Stanford-Binet Intelligence Scale, the Wechsler Intelligence Scales, the Wechsler Preschool and Primary Scale of Intelligence, and the Kaufman Assessment Battery for Children. For infants, the Bayley Scales of Infant Development may be used to assess motor, language, and problem-solving skills. Interviews with parents or other caregivers are used to assess the child's daily living, muscle control, communication, and social skills. The Woodcock-Johnson Scales of Independent Behavior and the Vineland Adaptive Behavior Scale are frequently used to evaluate these skills.

Mild mental retardation

Approximately 85% of the mentally retarded population is in the mildly retarded category. Their IQ score ranges from 50–70, and they can often acquire academic skills up to about the sixth-grade level. They can become fairly self-sufficient and, in some cases, live independently, with community and social support.

Moderate mental retardation

About 10% of the mentally retarded population is considered moderately retarded. These people have IQ scores ranging from 35–55. They can carry out work and self-care tasks with moderate supervision. They typically acquire communication skills in childhood and are able to live and function successfully within the community in such supervised environments as group homes.

Severe mental retardation

About 3–4% of the mentally retarded population is severely retarded. They have IQ scores of 20–40. They may master very basic self-care skills and some communication skills. Many severely retarded individuals are able to live in a group home.

Profound mental retardation

Only 1–2% of the mentally retarded population is classified as profoundly retarded. These individuals have IQ scores under 20–25. They may be able to develop basic self-care and communication skills with appropriate support and training. Their retardation is often caused by an accompanying neurological disorder. Profoundly retarded people need a high level of structure and supervision.

TREATMENT

The treatment team will depend on the underlying cause of mental retardation. A neurologist, neuropsychologist, child psychiatrist, and/or development pediatrician may be helpful for nearly all cases of mental retardation, both to assess underlying cause and to plan for appropriate and helpful interventions. Other members of the treatment team will depend on the underlying cause of mental retardation, accompanying medical problems, and the severity of the deficits.

Federal legislation entitles mentally retarded children to free testing and appropriate, individualized education and skills training within the school system from ages 3 to 21. For children under the age of three, many states have established early intervention programs that assess children, make recommendations, and begin treatment programs. Many day schools are available to help train retarded children in such basic skills as bathing and feeding themselves. Extracurricular activities and social programs are also important in helping retarded children and adolescents gain self-esteem.

Training in independent living and job skills is often begun in early adulthood. The level of training depends on the degree of retardation. Mildly retarded people can often acquire the skills needed to live independently and hold an outside job. Moderate to profoundly retarded persons usually require supervised community living in a group home or other residential setting.

Family therapy can help relatives of the mentally retarded develop coping skills. It can also help parents deal with feelings of guilt or anger. A supportive, warm home environment is essential to help the mentally retarded reach their full potential.

Although mental retardation is not treatable associated impairments are amenable to intervention and benefit from early identification.

Behavioral and emotional problems are common in children with mental retardation, but difficult to diagnose in severe mental retardation. Some behavioral

problems are unique to mental retardation such as self stimulations, self injurious and stereotypic behavior. Behavioral disorders result from mismatch between child's ability and demands of the situation, in organic problems or family difficulties. Represents child attempt to communicate gain attention or avoid frustration. Environmental setting such as appropriate classroom setting may improve. Behavior management technique and psychopharmacology technique are useful in some situations.

Drugs not useful in treating core symptoms of mental retardation. No agent is useful in improving intellectual function. Drugs are useful in treating associated behavioral and psychiatric disorders like ADHD, aggression, anxiety, depression, self injurious behavior.

Supportive care and management:

Management strategies for mental retardation are multimodal with efforts directed at all aspects of child life such as health, education, social, recreational activities, behavioral problems, associated impairments.

Primary care:

Anticipatory guidance to the child's functioning example feeding, toileting, school accident prevention, sexuality, education. Assessment of issues that are specific to child disorder, examination of teeth in child with bruxism, thyroid function test in children with down syndrome. Vision and hearing testing in all children.

Interdisciplinary management:

A periodic review should be done about health status and as well as functioning at home, school and in other settings. Psychologic and educational evaluation should be done at routine intervals or at any time the child is not meeting the expectations.

Educational services:

Single most important discipline involved in the treatment of children with intellectual disability. The educational program must be relevant to the child's needs and address the child's individual strengths. The child's developmental level, his or her requirements for support, and goals for independence provide a basis for establishing an Individualised Education Program (IEP) for school - aged children, as mandated by federal legislation.

Leisure and recreational activities:

Participation in sports should be encouraged since it offers many benefits like weight management, physical coordination, maintenance of cardiovascular fitness, improvement of self image. Social activities like dancing, trips and other recreational activities.

Family counseling:

There will be emotional, social difficulties in family, resulting in parental

depression and child abuse. These problems are less in stability of marriage, good parental self esteem, limited number of siblings, higher socioeconomic status, lesser degree of associated impairments, parental acceptance of diagnosis.

PROGNOSIS

The outcome of individuals with mental retardation depends on the underlying cause, the degree of cognitive and adaptive impairments, the capabilities of the families, and the social/community supports, services and training provided to the families.

Many child with mild mental retardation are capable of gaining economic and social independence with functional literacy. They may need periodic supervision especially when under social or economic stress. Life expectancy is not affected adversely by mental retardation itself.

For individuals with moderate mental retardation, the goals of education are to enhance adaptive abilities and survival, academic and vocasional skills so they are better able to live in the adult world the concept of supported employment is very useful to these individuals. These individuals generally live at home or in a supervised setting in the community.

For those with severe to profound retardation require extensive to pervasive supports. These individuals may have associated impairments such as cerebral palsy, behavioral disorders, epilepsy or sensory impairments that further limit their adaptive

functioning. These individuals are able to live in the community with appropriate supports.

SPECIAL CONCERNS

Prevention

Immunization against diseases such as measles and Hib prevents many of the illnesses that can cause mental retardation. In addition, all children should undergo routine developmental screening as part of their pediatric care. Screening is particularly critical for those children who may be neglected or undernourished or may live in disease producing conditions. Newborn screening and immediate treatment for PKU and hypothyroidism can usually catch these disorders early enough to prevent retardation.

Good prenatal care can also help prevent retardation. Pregnant women should be educated about the risks of alcohol consumption and the need to maintain good nutrition during pregnancy. Such tests as amniocentesis and ultrasonography can determine whether a fetus is developing normally in the womb.

AIM

To determine the diagnostic yield of neuroimaging in children with mental retardation.

MATERIALS AND METHODS

METHODOLOGY

PLACE : Department of Neurology, ICH & HC, Egmore.

PERIOD OF STUDY: November 2006 – October 2007

SAMPLE SIZE : 100 children

AGE GROUP : 3 years to 12 years

STUDY DESIGN : Descriptive study

MANOEUVRE

Cases required for the study are collected from Neurology out patient department of ICH & HC.

100 patients with mental retardation were included in the study.

A detailed medical, developmental, antenatal and perinatal history was taken.

Intelligent Quotient was assessed for all 100 patients with the help of psychologist of ICH & HC.

Two tests are used for IQ testing

1. Seguin form Goddard board test:

   This test is culture free and language free.

   For 3 years and above it is used

2. Binet Kamat test of intelligence:

   This test is a modification of Stanford Binet test.

Used for 3 years and above.

The severity of retardation was expressed as a percentage of chronological age (developmental age/chronological age x 100) and according to the level of severity, patients were grouped into three categories

Mild mental retardation	0 – 35%
Moderate mental retardation	36 – 50%
Severe mental retardation	51 – 70%

Growth parameters particularly head circumference was measured and head circumference less than third standard deviation were labeled to have microcephaly.

Complete physical examination was done paying special attention to facial dysmorphism that would give a clue to syndromic diagnosis.

A thorough neurological examination was also performed.

Urine for metabolic screening and thyroid function test were done for all cases.

CT scan was done for all 100 cases.

Data was recorded in the data entry given below

DATA ENTRY CARD

Findings in CT brain among mental retardation children between 3 – 12 years attending neurology out patient department

Name :

Age :

Sex :

Address:

Phone number:

Area : Urban

Rural

Maternal education: Illiterate

Primary schooling

Secondary schooling

Graduation

Father's occupation: Cooley

Clerical job

Self employed

High class

PRESENTING COMPLAINTS:

Large head

Small head

Delayed mile stones

Language delay

Stiffness or flaccidity of limbs

Hemiparesis

Quadriparesis

Hyperkinetic behavior

Movement disorder

Cerebellar dysfunction

Seizures

Others

Speech :

Normal

Delayed language

Dysarthria

Others

Vision: Normal

Affected

Hearing: Normal

Affected

Seizures: Absent

GTCS

Focal

Myoclonic

Mixed

Others

RELEVANT HISTORY

Past history: CNS infections

Head injury

Hypoxic illness

Drowning

Status epilepticus

Antenatal history: Infections

Radiation

Drug intake

Antiepileptic

	Alcohol
	Medical illness
	Malnutrition
Birth and neonatal:	
Place of delivery:	Home
	Hospital
Term of delivery:	Full term
	Preterm
	Post term
Type of delivery:	Normal
	Forceps
	Vacuum
	LSCS
Birth weight:	Normal

Low birth weight

Post natal history: Delayed cry

Respiratoty distress

Cyanosis

Injury

Infection

Jaundice

Seizures

Associated medical illness: Hypothyroidism

Chromosomal

Abnormality

Inborn error of Metabolism

Mucopolysaccharidoses

Family history: Consanguinity

H/o mental retardation

H/o similar illness in other family members

Developmental history: Normal

Delayed

Social smile

Head control

Crawling

Walking

Speech

EXAMINATION

General examination: Anaemia

Cyanosis

Clubbing

Lymphadenopathy

Malnutrition

Microcephaly

Facial dysmorphism

Neurocutaneous markers

External congenital Anomalies

Others

Anthropometry : Height

Weight

Head circumference

Higher functions:

Speech: Normal

Baby speech

Slurred

Fluent

Dysarthria

Reading: Normal

Abnormal

Writing: Letters

Numbers

Attention span: Normal

Decreased

Vision: Normal

Affected

A. Ocular cause

B. Optic atrophy

C. Cortical blindness

Motor system: Hemiplegia

Quadriplegia

Diplegia

Akinesia / dyskinesia

Myoclonic jerk

Tic

Neurodevelopmental disorder: ADHD

Autism

Others

Intelligent Quotient Assessment: 1. Seguin Form Goddard Board test

2. Binet Kamat Test of Intelligence

Urine for metabolic screening:

Thyroid function test:

Neuroimaging :

CT scan Brain

Final diagnosis:

REVIEW OF LITERATURE

Pandey et al, studied a role of neuroimaging in mental retardation, at sanjay Gandhi post graduate institute of medical sciences, Lucknow.

In this study neuroimaging was done in 47 patients where no etiologic diagnosis could be made following clinical examination and preliminary investigation. (CT – 35, MRI – 12). Abnormal findings noted in 30 patients (63.82%) of which 19 (42.42%) showed positive etiological findings.

According to the study abnormal findings in neuroimaging increased with the severity of mental retardation, presence of microcephaly and neurological deficits.

In this study out of 35 cases where CT scan was done 20 showed abnormalities (57%). Although MRI is superior to CT, Sufficient information may be achieved with CT in situation with limited access.

Another study by Kjos et al reported a 34% positivity of MRI in mental retardation.

In patients of mental retardation with microcephaly, abnormality was noted in 78% which is comparable to 67% reported by steinlin et al.

A study by Dr. Agatino Battaglia, Adjunct Professor of Pediatric Neurology at the University of Pisa, has suggested that neuroimaging, CT scan and MRI brain, appears to have an especially important role in patients with microcephaly or macrocephaly,

seizures, loss of psychomotor skills and neurologic signs," whereas the value of neuroimaging investigations "in the normocephalic patient without focal neurological signs is unclear.

Kazuhiro Hashimoto, Hisaya Hasegawa, Yoshikazu Kida and Yutaka Takeuchi, Division of Neonatal Medicine, Matsudo City Hospital, Matsudo, Chiba and Division of Child Neurology, Institute of Neurological Sciences, Tottori University School of Medicine, Yonago, Tottori, Japan studied Correlation between neuroimaging and neurological outcome in periventricular leukomalacia.

In the present study, we investigated 747 preterm infants of less than 36 weeks gestation who were repeatedly examined by cranial ultrasonography and computed tomography (CT) scanning at around 40 weeks of corrected post-menstrual age. The clinical course of these infants was followed for more than 3 years and they were examined by magnetic resonance imaging (MRI) between 12 and 18 months of age : Single examinations in early infancy were not sufficient to diagnose PVL, but the combination of ultrasonography, CT and MRI examinations allowed the clinical diagnosis of PVL. In preterm infants, clinical PVL could be predicted from cystic PVL and periventricular echogenicity prolonged over 3 weeks on ultrasonography and confirmed by MRI after 11 months of corrected age. They tried to determine diagnostic criteria for PVL by neuroimaging. Such criteria from neuroimaging for PVL may be useful for determining the exact occurence rate of and clinical risk factors for PVL.

ANALYSIS AND DISCUSSION

A total number of 100 children with Mental Retardation were studied.

Among 100 children with Mental Retardation 61(61%) were male and 39(39%) were female. Hence there is high prevalence of Mental Retardation in male (Table 1).

IQ assessment was done for all cases.

Based on IQ assessment patients were grouped as

Mild mental retardation	51 – 70%
Moderate mental retardation	36 - 50%
Severe mental retardation	0 - 35%

Among 100 Mental retardation children 39 cases came under mild mental retardation, 26 came under moderate mental Retardation and 35 came under severe mental retardation (Table 1).

SEX DIS7TRIBUTION IN CHILDREN WITH MENTAL RETARDATION

TABLE 1

Mental retardation children	**Male**	Fema le	**Total**
Mild mental retardation (IQ 51-70%)	28	11	39
Moderate mental retardation (IQ 36-70%)	14	12	26
Severe mental retardation (IQ 0-35%)	19	16	35
Total	**61**	**39**	**100**

CT scan done in 100 mental retardation children was abnormal in 63 cases (63 %) and normal in 37 cases (37%) (Table 2).

Out of 39 mild mental retardation children CT was abnormal in 16 cases (41%) and normal in 23 cases. Out of 26 cases of moderate mental retardation CT was abnormal in 18 cases (69%) and was normal in 8 cases. Out of 35 cases of severe mental retardation children CT was abnormal in 29 cases (83%) and normal in 6 cases.

EXTENT OF LESIONS IN CT SCAN

Lesions in CT scan was focal in 17 cases (27%) and extensive in 47 cases (73%). (Table 3)

In mild mental retardation children, out of 16 cases with abnormal neuroimaging findings 10 (63%) were extensive lesions and 6 (27%) were focal lesions. In 18 cases of moderate mental retardation children with abnormal CT findings extensive lesions were seen in 11 cases (61%) and focal lesions were seen in 7 cases (39%).

ABNORMAL CT SCAN FINDINGS
TABLE 2

CT scan Findings	Mild mental retardation	Moderate mental retardation	Severe mental retardation	Total
Abnormal	16 (41%)	18 (69%)	29 (83%)	63 (63%)
Normal	23	8	6	37
Total	**39**	**26**	**35**	**100**

EXTENT OF LESIONS IN CT SCAN
TABLE 3

Lesions in CT scan	Mild mental retardation	Moderate mental retardation	Severe mental retardation	Total
Focal lesion	6	7	4	17
Extensive lesion	10 (63%)	11 (61%)	25 (86%)	46 (73%)
Total	16	18	29	63

In severe mental Retardation, out of 29 cases with abnormal CT findings, extensive lesions were seen in 25 cases (87%) and focal lesions were seen in 4 cases

(16%).

ASSOCIATION OF PERINATAL ASPHYXIA WITH MENTAL RETARDATION

Out of 100 children with mental retardation history of perinatal asphyxia was present in 56 children (56%) and absent in 44 children (44%) (Table 4).

Out of 39 cases with mild mental retardation history of birth asphyxia was positive in 15 cases (38%) and negative in 24 cases (66%). In 26 cases with moderate mental retardation children birth asphyxia history was positive in 16 cases (62%) and absent in 10 cases (38%). In 35 cases of severe mental retardation birth asphyxia history was positive in 25 cases (71%) and absent in 10 cases (29%).

ASSOCIATION OF NEUROLOGICAL DEFICIT WITH MENTAL RETARDATION

Out of 100 mental retardation children, neurological deficit in the form of quadriplegia, hemiplegia, diplegia was seen in 36 cases (36%) and absent in 64 cases (64%). (Table 5)

In mild mental retardation neurological deficit was seen in 11 cases (28%) out of 39 cases. In moderate mental retardation neurological deficit was seen in 8 cases (31%) out of 26 cases. In severe mental retardation neurological deficit was associated in 17 cases (49%) out of 35 cases.

ASSOCIATION OF PERINATAL ASPHYXIA WITH MENTALRETARDATION

TABLE 4

Perinatal Asphyxia	Mild mental retardation	Moderate mental retardation	Severe mental retardation	Total
Present	15 (38%)	16 (62%)	25 (71%)	56 (56%)
Absent	24	10	10	44
Total	**39**	**26**	**35**	**100**

ASSOCIATION OF NEUROLOGICAL DEFICIT WITH MENTAL RETARDATION

TABLE 5

Neurological Deficit	Mild mental retardation	Moderate mental retardation	Severe mental retardation	Total
Present	11 (28%)	8 (31%)	17 (49%)	36 (36%)
Absent	28	18	18	64
Total	**39**	**26**	**35**	**100**

ASSOCIATION OF SEIZURES WITH MENTAL RETARDATION

Out of 100 mental retardation children seizures were present in 59 cases (59%) and absent in 41 cases (41%).

In 39 cases with mild mental retardation seizures were seen in 17 cases (44%) and absent in 22 cases. In 22 cases with moderate mental retardation seizures were present in 20 cases (77%) and absent in 6 cases. In 35 cases of severe mental retardation seizures were present in 22 cases (63%) and absent in 13 cases.

ASSOCIATION OF MICROCEPHALY WITH MENTAL RETARDATION

Out of 100 mental retardation children microcephaly was seen in 56 patients (56%) and absent in 44 cases.

Out of 39 mild mental retardation cases microcephaly was seen in 15 cases (38%) and absent in 24 cases. In 26 cases of moderate mental retardation microcephaly was seen in 12 cases (46%) and absent in 14 cases. In 35 cases of severe mental retardation microcephaly was seen in 29 patients (83%) and absent in 6 cases. Hence presence of microcephaly increased with the severity of mental retardation.

ASSOCIATION OF LOW BIRTH WEIGHT WITH MENTAL RETARDATION

In 100 mental retardation children low birth weight was seen in 29 cases (29%) and absent in 79 cases.

In 39 cases of mild mental retardation low birth weight was seen in 14 cases (36%). In 26 cases moderate mental retardation low birth weight was seen in 8 cases (31%). In 35 cases of severe mental retardation low birth weight was seen in 7 cases (20%).

ASSOCIATION OF SEIZURES WITH MENTAL RETARDATION
TABLE 6

Seizures	Mild mental Retardation	Moderate mental retardation	Severe mental retardation	Total
Present	17 (44%)	20 (77%)	22 (63%)	59 (59%)
Absent	22	6	13	41
Total	**39**	**26**	**35**	**100**

ASSOCITION OF MICROCEPHALY WITH MENTAL RETARDATION

TABLE 7

Microcephaly	Mild mental Retardation	Moderate mental retardation	Severe mental retardation	Total
Present	15 (38%)	12 (46%)	29 (83%)	56 (56%)
Absent	24	14	6	44
Total	**39**	**26**	**35**	**100**

ASSOCIATION OF LOW BIRTH WEIGHT WITH MENTAL RETARDATION

TABLE 8

Low birth weight	**Mild mental Retardation**	**Moderate mental retardation**	**Severe mental retardation**	Total
Present	14 (36%)	8 (31%)	7 (20%)	29 (29%)
Absent	25	18	28	71
Total	**39**	**26**	**35**	**100**

TYPE OF ABNORMALITIES SEEN IN CT SCAN OF 100 MENTAL RETARDATION CHILDREN

ABNORMAL FINDINGS	NUMBER OF PATIENTS
Cerebral atrophy	28
Infarct	21
Porencephalic cyst	5
Post HIE sequelae	2
Hydrocephalus	1
Lissencephaly	1
Periventricular calcification	1
Basal ganglia calcification	4
Total	63

Atrophy characterized by enlarged ventricles and widening of sulci was the most common finding on CT scan and was seen in 28 patients (44.44%). It was increasingly found in patients with microcephaly, neurological deficit than in patients without neurological deficit. Cerebral atrophy was focal in 4 patients and was generalized in remaining patients.

Next common abnormal finding was infarct and was seen in 21 patients (33%). It was focal in 4 patients and was diffuse in remaining patients characterized by hypodense

lesion, gliotic changes with cerebral atrophy and passive dilatation of ventricles. It was associated increasingly in patients with perinatal asphyxia and neurological deficit. In one patient there was history of CNS infection.

Porencephalic cyst was seen in 5 patients. In one patient cyst was large associated with cerebral atrophy and communicating with lateral ventricle. In other 4 cases cyst was small communicating with ventricle and associated with cerebral atrophy and passive dilatation of ventricle. This was also increasingly seen in patients with neurological deficit group than only mentally retarded group.

Post HIE sequelae was seen in 2 patients in the form of cystic encephalomalacia infarct, cerebral atrophy and passive dilatation of ventricles.

Hydrocephalus was seen in one patient. There was arrested hydrocephalus with prominent lateral and third ventricle.

Lissencephaly was identified in one patient. There was minimal sulci gyri differentiation with small anterior fissure and both frontal lobes fused. It was associated with microcepthaly and seizures.

Periventricular calcification was seen in one patient suggestive of congenital infection. It was associated with microcephaly, quadriplegia and severe mental retardation.

DISCUSSION

The aim of investigating a child with mental retardation is to reach etiologic diagnosis. Though not always diagnostic CT scan provides valuable information in a relatively high percentage of children.

The sensitivity of neuroimaging in this study was 63% of which 49% gave clue to etiologic diagnosis. Such high sensitivity can be attributed to versatality of neuroimaging in providing diagnostic information about vascular, infective insult, abnormal morphology of brain.

This is comparable to those of Pandey et al at sanjay Gandhi post graduate institute of medical sciences, Lucknow. In this study neuroimaging was done in 47 patients. (CT – 35, MRI – 12). Abnormal findings noted in 30 patients (63.82%) of which 19 showed positive etiological findings.

According to the study abnormal findings in neuroimaging increased with the severity of mental retardation, presence of microcephaly and neurological deficits.

In this study out of 35 cases where CT scan was done 20 showed abnormalities (57%). Although MRI is superior to CT,

Sufficient information may be achieved with CT in situation with limited access.

Another study by Kjos et al reported a 34% positivity of MRI in mental

retardation.

In patients of mental retardation with microcephaly, abnormality was noted in 78% which is comparable to 67% reported by steinlin et al.

Based on history alone diagnosis of perinatal insult is erroneous and documentation of imaging finding suggestive of ischemia or hypoxia is an important diagnostic evidence. Though imaging may not provide exact time of insult or specific cause of the same, parents can be assured of a negligible risk of recurrence.

Perinatal infection is an important cause of brain damage but because of an extreme variability of presentation clinical diagnosis is difficult. Serological investigations to rule out infections are inconclusive unless they are done in neonatal period or infancy.

Congenital morphogenetic abnormalities represent disorders in development occurring early in gestation, one patient had Lissencephaly associated with microcephaly in present study.

The application of neuroimaging does not facilitate any specific management in the retarded children nor does it alter the patients developmental delay.

Nevertheless it is immensely useful in providing valuable information regarding an etiological basis for the mental retardation.

This greatly helps the clinician in counseling the concerned families and it enables the parents to make informed decisions regarding reproductive choices.

An etiologic diagnosis provides for a more accurate prognosis. In the present study after neuroimaging 49% could be councelled about the recurrence risk.

Finding cause help them to accept the problem better and stop their effort for diagnosis and pay more attention to training and other supportive management of the child.

CONCLUSION

In the study 63% showed abnormal findings in CT scan of which 49 % showed positive etiological findings.

Abnormal findings on neuroimaging was higher in mental retardation children with microcephaly, neurological deficits, seizures etc.

Generalized cerebral atrophy with passive dilatation of ventricles was the most common finding in 44% of cases, followed by infarct in 33% of cases. Other findings were porencephalic cyst (8%) post HIE sequelae (3%) Hydrocephalus (1.6%) Lissencephaly (1.6%), Periventricular calcification (1.6%), Basal ganglia calcification (6.3%).

Sensitivity of neuroimaging in this study was 63% and such high sensitivity can be attributed to versatality of neuroimaging in providing diagnostic information about vascular, infective insult, abnormal morphology of brain.

The etiologic diagnosis was possible in 49% of cases, hence the recurrence risk of similar problem in subsequent pregnancy could be counseled in 49% of cases.

It is recommended that if an etiological diagnosis is not readily apparent after a detailed history, examination and initial investigation, neuroimaging should be standard clinical practice for a child with global developmental delay.

Neuroimaging should be considered in patients without a known diagnosis especially in the presence of microcephaly, neurological deficits, seizures etc. since the frequency of abnormal findings are more when mental retardation is associated with neurologic deficits than in only retarded group.

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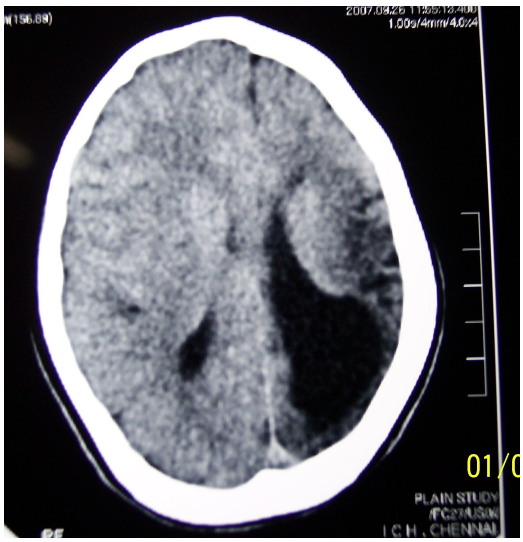

Figure 1. CT picture showing porencephalic cyst left communicating with lateral ventricle with cerebral atrophy of left hemisphere.

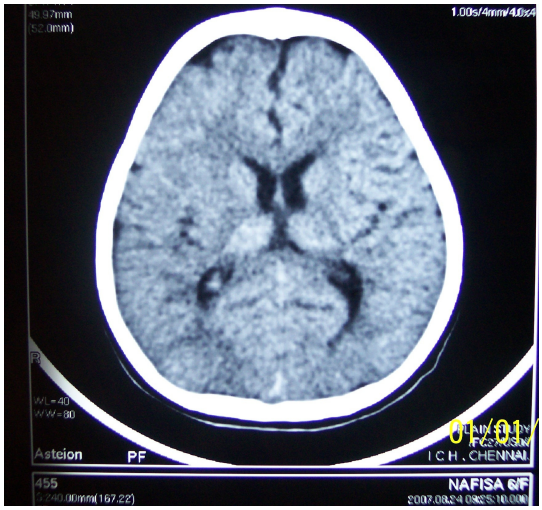

Figure 2. CT picture showing bilateral basal ganglia calcification.

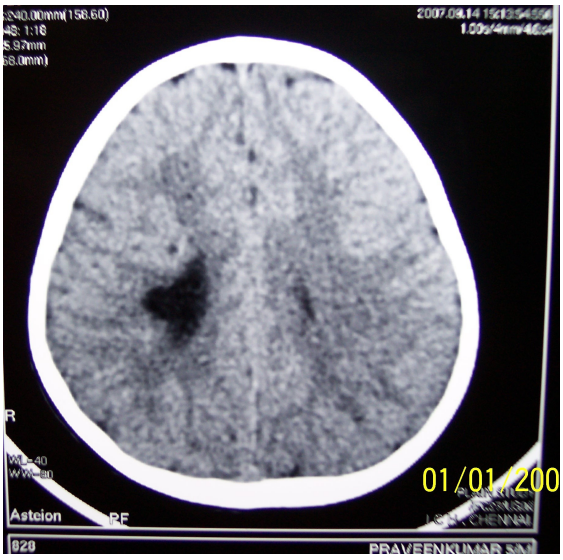

Figure 3: CT picture showing dilatation of body and occipital horn of right lateral ventricle with small porencephalic cyst right parietal region communicating with right ventricle.

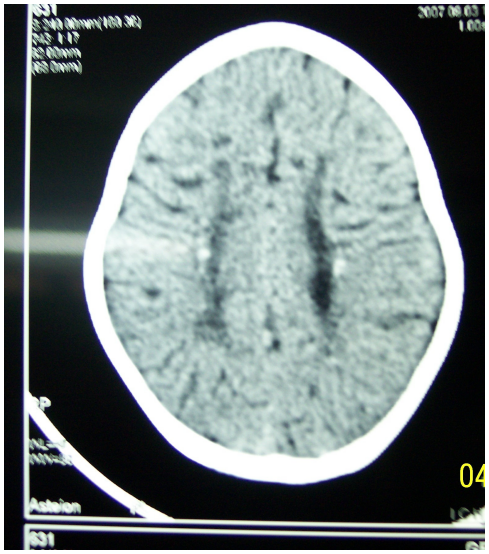

Figure 4. CT picture showing periventricular calcification

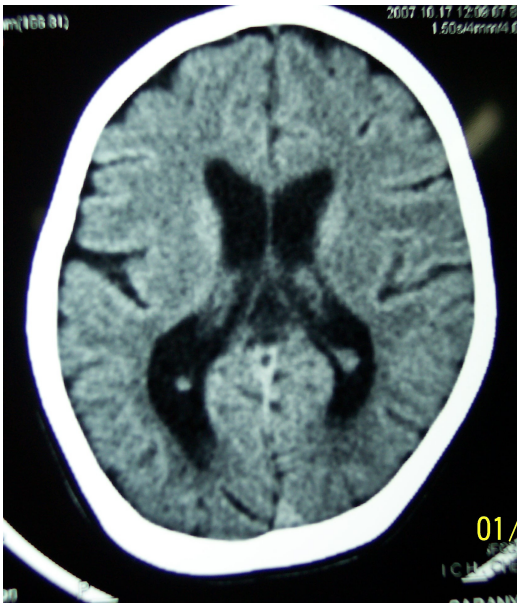

Figure 5. CT picture showing diffuse cerebral atrophy with passive dilatation of ventricles.

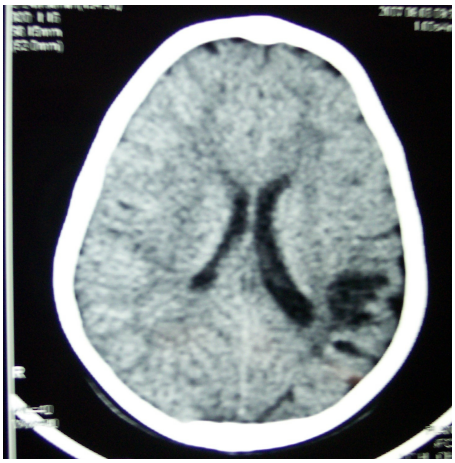

Figure 6. CT picture showing hypodense lesion left occipitoparietal region probably chronic infarct with passive dilatation of occipital horn of left lateral ventricle